WooKong Multi Rotor

User Manual

Revision 1.9

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http://www.dji-innovations.com

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Warning & Disclaimer

WKM is an excellent autopilot system offering tremendous flight features for low altitude multi rotor working in restricted space compared to normal helicopter. It is not a toy when installed in multi rotors of any size. Despite our efforts in making the controller to operate in the safest manner when the main power battery is connected, such as: disabling MC signal to ESCs when USB is connected; disabling throttle input and stick command when throttle stick is not at the lowest position, we strongly recommend customers to remove all propellers, use power supply from R/C system or flight pack battery, and keep children away during system calibration and parameter setup. Dajiang Innovation Technology Co. Ltd. assumes no liability for damage(s) or injuries incurred directly or indirectly from the use of this product.

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Reader's Guide

Please strictly follow these steps to mount and connect WooKong for Multi Rotor (WKM) system on your multi rotor, as well as to install the Assistant software on your computer.

Icons seen in this document:


FORBIDDEN


CAUTION


Correct


Wrong


Please refer to the page(s) mentioned


Assembly& Mounting Tips


General Tips

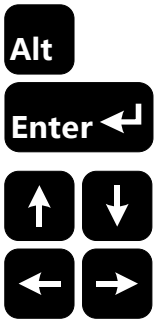

Assistant software configuration required

R/C Transmitter configuration required


Mouse Left Click


Mouse Right Click

Ctrl Key



Alt Key

Enter Key

Up/Down Left/Right Directions Keys

Contents

Package Items

Main Controller (MC)

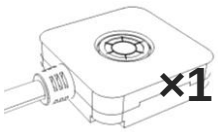
The Main Controller (MC) is the brain of the system, it communicates with the IMU, GPS/Compass，ESC and RC transmitter to carry out autopilot functionality. The Main Controller provides USB interface to configure MC and update firmware from a PC (System requirement: Windows XP SP3 or 7)

GPS & Compass

The GPS/Compass module is for sensing the position and direction.

LED Indicator

The LED indicates different states of system.

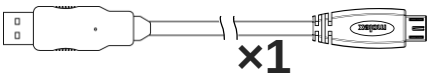


IMU

The Inertial Measurement Unit (IMU) consists of one 3-axis accelerometer, one 3-axis gyroscope and a barometer. It is for sensing the attitude.

USB Cable

This cable is used to configure MC and update firmware.

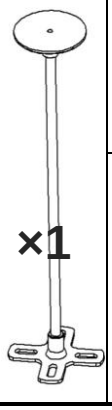


3-PIN Servo Cable

Cables used to connect the Main Controller to the RC receiver.

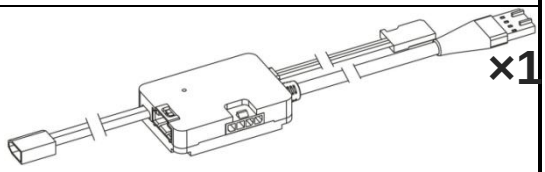
GPS Bracket

Because the GPS/Compass is sensitive to magnetic interference, you should use this bracket to mount the GPS module.



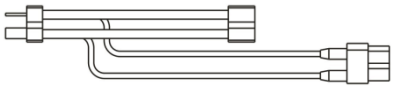
Power Management Unit (PMU)

Specially designed for WKM to solve the high power consumption problem of power support system. It contains two power outputs for entire WKM system and receiver separately, a battery voltage monitor, and two CAN-Bus interfaces.



Power Connection Adapter

For connections among Battery, ESCs and PMU.



Warranty Information Card

It recommends the necessary conditions for using WKM system and related safety issues. Please fill out the customer & multi rotor information card and return to DJI to register your product warranty.

Matters Need Attention

For safety reasons, please pay serious attention to all following items:

1. **Please disconnect ESCs and Power Connection Adapter or remove all propellers during configuration and system setup !**
2. **Do not mount the IMU upside-down.**
3. **You have to reboot MC and redo the Tx calibration after you change receiver.**
4. **In Tx Calibration of assistant software:**
   - **Throttle: Slide left is craft down, slide right is craft up;**
   - **Rudder: Slide left is nose left, slide right is nose right;**
   - **Elevator: Slide left is craft back, slide right is craft front;**
   - **Aileron: Slide left is craft left, slide right is craft right.**
5. **GPS/Compass is sensitive to magnetic interference, should be far away from any electronic devices.**
6. **Make sure switch on the transmitter first, then power on multi-rotor before takeoff! Power off multi-rotor first, then switch off the transmitter after landing!**
7. **Do not fly in GPS Mode when the signal is not good (red light blinks)!**
8. **If you open the gimbal control in assistant software during the configuration, please note that there is output from F1 and F2 ports. Now you should not connect these ports to ESCs which is wired with propellers equipped motors.**
9. **Do NOT set the failed-safe position of throttle under 10% of endpoint.**
10. **Throttle stick position should always be higher than 10% from cut-throttle during the flight!**
11. **Low voltage protections are NOT fun! You should land your multi-rotor ASAP in any level of protection to prevent your multi-rotor from crash or other harmful consequences!**
12. **In *Atti* and *GPS Atti mode*, throttle stick center position is for 0m/s on the vertical direction. If you pull the stick to the**

bottom during the flight, multi-rotor will descend; if you pull the stick to the bottom on the ground, it will cut motors in 3 seconds. However the slow spinning of motors will affect the flight performance, you'd better keep throttle stick position higher than 10% from cut-throttle during the flight! In *Manual Mode* it will cut motors when pull throttle stick under 10%.

DJI WKM Introduction

DJI WKM for Multi Rotors (WKM) is an autopilot system designed for serious multi rotor enthusiasts providing GPS for self-leveling and position holding, which completely takes the stress out of flying RC multi rotors for both professional and hobby applications. WKM can be installed in a variety of models from quad-rotor to octo-rotor.

Multiple control modes based on autopilot system

Modes / Features	*GPS Atti. Mode*	*Atti. Mode*	*Manual Mode*
Command Stick Meaning	Multi attitude control; Stick center position for 0° attitude, its endpoint is 35°.		Maximum angular velocity is 150 degree/s. No attitude angle limitation and vertical velocity locking.
Command Linearity	YES		
Stick Released	Lock rotor position when GPS signal is adequate.	Only attitude stabilizing.	NOT Recommend
Altitude lock	Maintain the altitude best above 1 meter from ground.		NO
GPS Lost	After 10s when GPS signal lost, System enters ***Atti. Mode*** automatically.	Only performing attitude stabilizing without position lock.	---
Safety	Attitude & speed mixture control ensures stability; Enhanced fail-safe		Depends on experience.
Applications	Aerial photography work.	Sports flying.	---

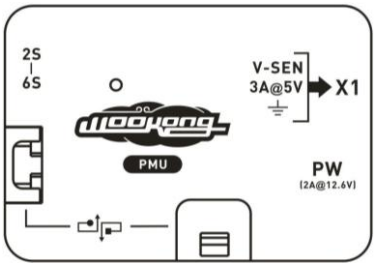
Ports Introduction

Main Controller

A	For roll control (left/right)		M6	To #6 rotor	
E	For pitch control (front/back)		M5	To #5 rotor	
T	For throttle control	Or to gimbal roll servo	M4	To #4 rotor	
R	For rudder control	Or to gimbal pitch servo	M3	To #3 rotor	
U	For Control Mode Switch		M2	To #2 rotor	
X1	For voltage monitor		M1	To #1 rotor	
X2	For D-Bus (S-Bus compatible)	Or for gain tuning	F2	To gimbal pitch servo	Or to #8 rotor
X3	For gain tuning	Or for gimbal pitch control	F1	To gimbal roll servo	Or to #7 rotor
	Micro-USB port: PC connection for configuration and firmware upgrades.			CAN-Bus port: MC uses CAN-Bus to power and communicate with other WKM modules.	

1. You can use T and R ports for gimbal control only if you choose D-Bus and Octo-rotor in assistant software.
2. If you open the gimbal control in assistant software during the configuration, please note that there is output from F1 and F2 ports. Now you should not connect these ports to ESCs which is wired with propellers equipped motors.

Power Management Unit



■ PW Port

This port provides power to whole WKM system (MC, IMU, GPS, LED) which does not need to get power from any 3-pin servo port. The output voltage is 12.6V If input voltage from battery is higher than 13V; the output voltage will follow the change of input voltage (0.4V lower than it) If input voltage from battery is lower than 13V. Its maximum output current is 2A.

WKM can still get power from 3-pin servo ports if the PW port does not function well.

■ V-SEN Port

This port has two functions: 1) It collects the power input of the PMU for MC to monitor the battery voltage. The white wire from this port is the signal wire, and its maximum output voltage is 3.3V, so it will not damage your receiver if you connect this port to it. 2) It provides a 3A@5V power on red wire for the receiver and other electronic device through X1 port on MC.

1. Since the working current of some gimbal servos are large, this port may not drive three axial gimbal, please use extra high-power UBEC.
2. Our BEC in PMU is powerful enough to drive receiver and most of the other electronic devices. However if you want to use other BEC, you'd better use a 3-pin servo cable without red wire to connect V-SEN and X1 on MC.

Mounting and Connection

Note: Failure to follow any guidance outlined in this page will have severe consequence of your multi-rotor flight characteristic or worst crashing your multi-rotor or bodily harm.

IMU:

- The IMU is best positioned near the multi rotor's center of gravity, where vibration is relatively low.
- Orient the IMU such that the arrow marked on the printed surface of the IMU faces the sky and points directly forward, backward, left or right.
- The sides of the IMU should be precisely parallel to the multi rotor body. Use double-sided foam tape for secured installation.

⚠

- Check the double faced adhesive tape regularly to ensure that the IMU is securely positioned.

⊘

- DO NOT cover the ventilation holes, keep them unobstructed.
- The IMU module is NOT water-proof or oil-proof.
- Do not mount the IMU upside-down.

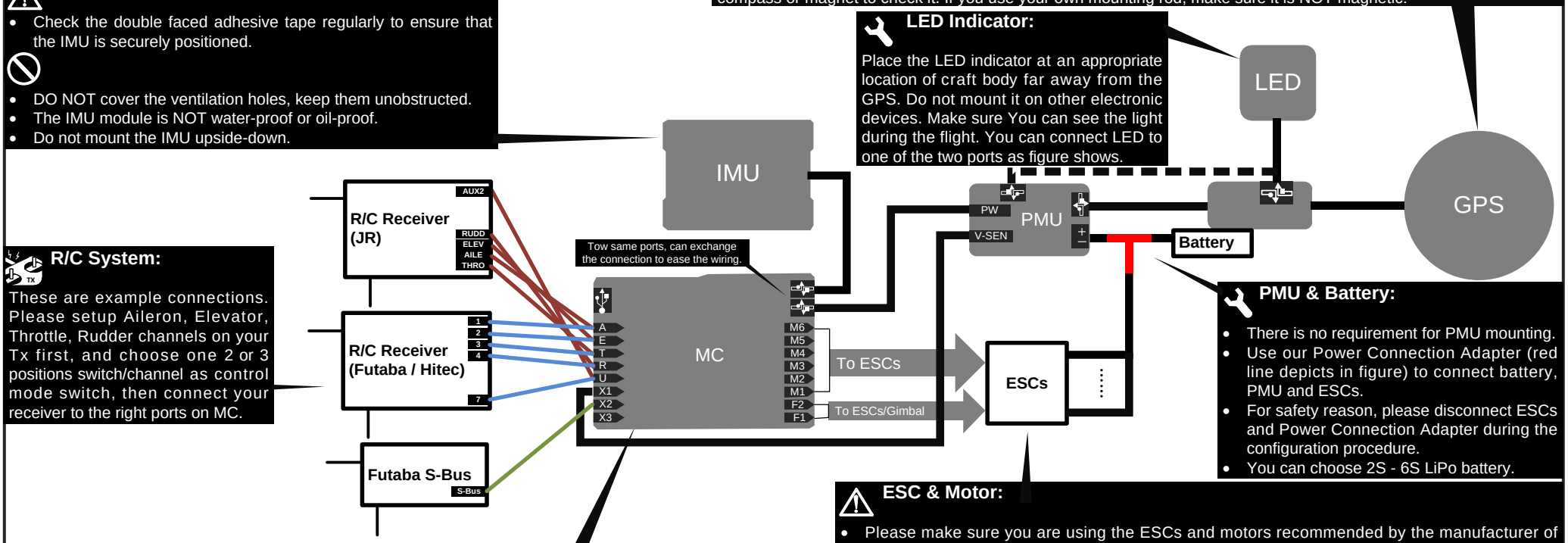
GPS/COMPASS (with Bracket):

- GPS/Compass is sensitive to magnetic interference, should be far away from any electronic devices.
- You should use epoxy resin AB glue to assemble the GPS bracket first as the figure showed in previous page.
- Mount the bracket on the center plate of craft first, then fix the GPS on the plate of the bracket (by 3M glue provided). The GPS is sensitive to vibration interference, so position the bracket at least 10 cm from any rotor.
- The DJI logo marked on the GPS should face the sky, with the orientation arrow pointing directly forward. The GPS/Compass is packaged with a special indication line for mounting for the first time.

If you are uncertain whether materials near the GPS/Compass module are magnetic or not, you can use a compass or magnet to check it. If you use your own mounting rod, make sure it is NOT magnetic!

LED Indicator:

Place the LED indicator at an appropriate location of craft body far away from the GPS. Do not mount it on other electronic devices. Make sure You can see the light during the flight. You can connect LED to one of the two ports as figure shows.



R/C System:

These are example connections. Please setup Aileron, Elevator, Throttle, Rudder channels on your Tx first, and choose one 2 or 3 positions switch/channel as control mode switch, then connect your receiver to the right ports on MC.

PMU & Battery:

- There is no requirement for PMU mounting.
- Use our Power Connection Adapter (red line depicts in figure) to connect battery, PMU and ESCs.
- For safety reason, please disconnect ESCs and Power Connection Adapter during the configuration procedure.
- You can choose 2S - 6S LiPo battery.

Main Controller:

- There is no orientation requirement for the Main Controller. Choose a mounting location where as shorter ESC extension wires are needed as possible. Please make sure all ports are accessible when installing the MC so as to facilitate wiring and software configuration.
- In three-pin ports, pins near the nicks are signal pins.

⚠ After choosing a location to mount the MC, it is recommended that you DO NOT mount the MC until all wirings and software configurations are completed.

ESC & Motor:

- Please make sure you are using the ESCs and motors recommended by the manufacturer of your multi rotor first. Supported ESC output by WKM is 400Hz refresh frequency. We recommend the use of external switching type BEC of 5A or higher for all AP work and larger than 650 size multi-rotor, and cut the red wire of ESCs with built-in BEC.
- Connect ESCs to motors, then calibrate all your ESCs one by one through the receiver directly before connect them to your MC, Make sure program all of them into Governor off, Break off and Normal Start up to get best experience.
- Connect all ESCs to MC by the motor numbering method introduced in our Assistant software.
- Cut the red wire (power wire) of your ESCs , the power from V-SEN on PMU is suitable to most of receivers and other electronic devices. If you want to use other BEC to drive these devices, you'd better use a 3-pin servo cable without red wire to connect V-SEN to X1. We recommend the former connection, which can protect your motors and ESCs.

Assistant Software

Software and Driver Installation

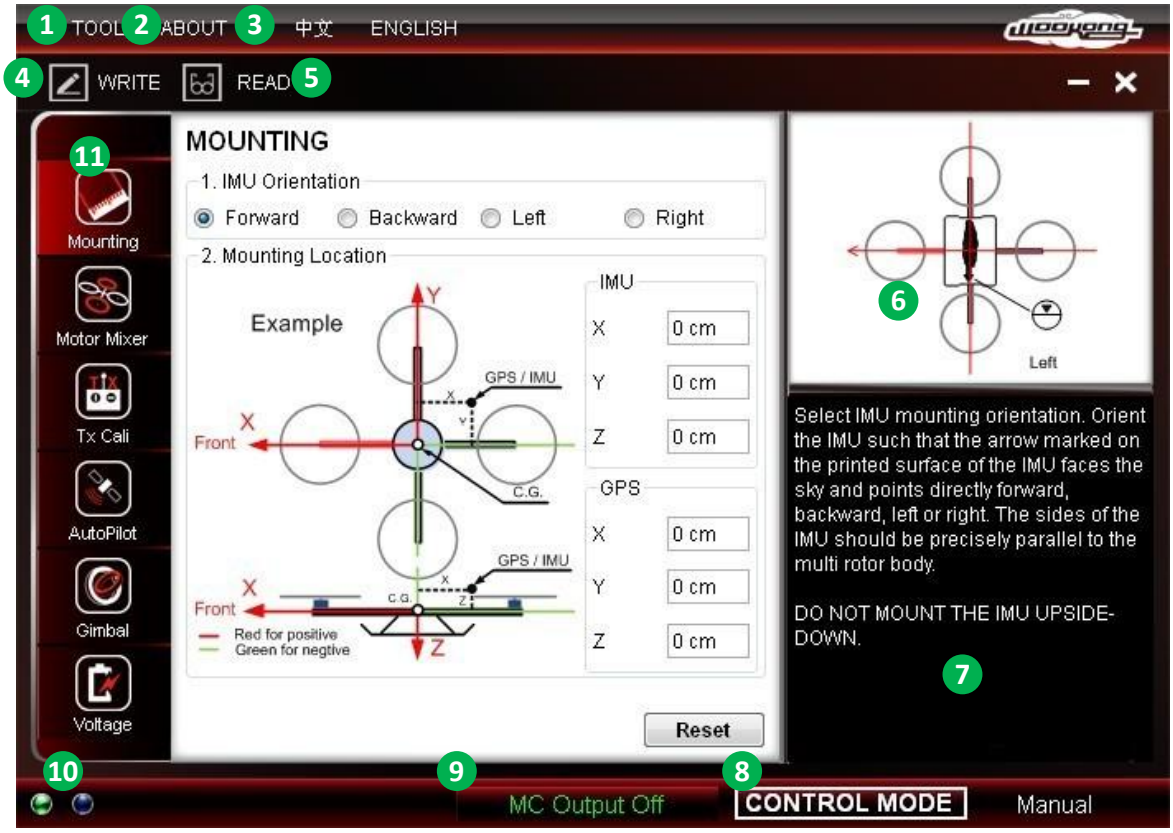
STEP1: Please download assistant software and driver from our website. If your operating system is 32bit, download 32bit driver; if your operating system is 64bit, download 64bit driver. Then decompress;

STEP2: Connect MC and PC via USB cable, power on MC;

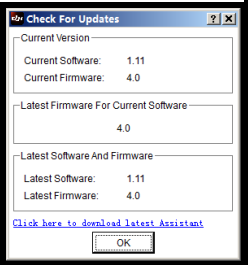
STEP3: If operating system tries to install driver automatically, cancel it.

STEP4: Open driver folder DJI_Wookong_M_Driver_32bit or DJI_Wookong_Multi_Rotor_Driver_64bit, double click Driver Setup.bat file and follow the steps to finish installation.

STEP5: Open the assistant software folder, double click Setup.exe file and follow the steps to finish installation.



Please power the MC first, then connect your MC to a internet enabled computer by the USB cable before you open the assistant software. You have to register at the first time you use the assistant software. It will auto detect software version when you open the assistant software and prompt message if your version is not the latest one:



1 **TOOL**

- ➔ **Firmware upgrade**: update your firmware from DJI server, keep your WKM system up-to-date.
- ➔ **Disable All Knob**

2 **ABOUT**

- ➔ **Info**: Information regarding your WKM
- ➔ **Error Code**

3 **Language**:

- ➔ **中文**
- ➔ **English**

4 **Write:** Write data of the current page to your MC. The parameter or the title of which will turn red and bold when modified, make sure you click the "Write" button or press Enter to update your system. Optional parameters will be written to MC directly after modification.

5 **Read:** read parameters from MC for current page.

6 **Graphic guidance**

7 **Text guidance**

8 **Control mode indication**

9 MC Output On Indicates there are outputs to ESCs; when communication is built up between MC and assistant software via USB cable, MC Output Off appears, it indicates no output to motors, then you can configure your multi rotor with assistant software more safely!

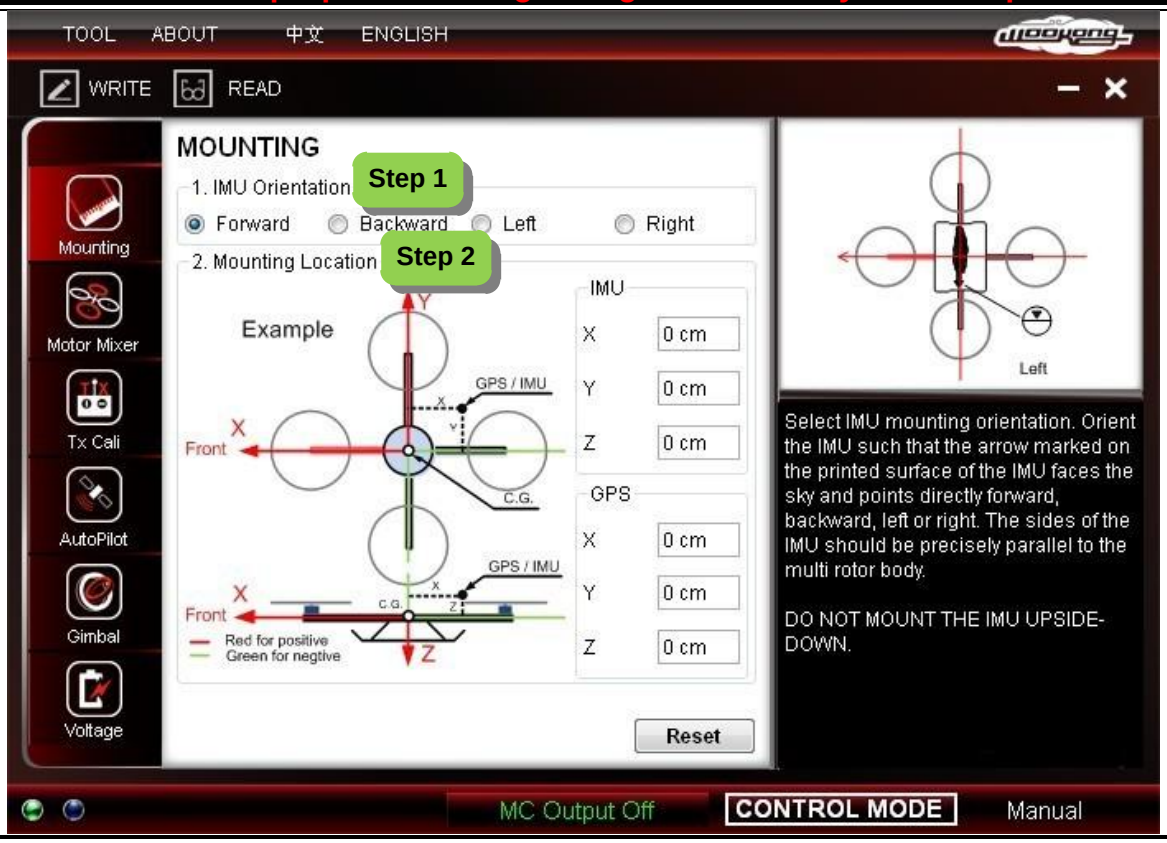
10 **Red light:** WKM←→ PC has been disconnected.
Green light: WKM←→ PC has been connected.
Blue light: WKM←→ PC communication.

11 Here you can find all the configuration pages

Configuration Procedure

1. Mounting

For safety reasons, please disconnect ESCs and Power Connection Adapter or remove all propellers during configuration and system setup!



STEP1: ***IMU Orientation***

Select IMU mounting orientation. Orient the IMU such that the arrow marked on the printed surface of the IMU faces the sky and points directly forward, backward, left or right. The sides of the IMU should be precisely parallel to the multi rotor body.

DO NOT MOUNT THE IMU UPSIDE-DOWN.

STEP2: ***Mounting Location***

Install all payloads that will be used during the flight, including batteries, camera mount and camera. Balance the multi rotor as you would normally, with the center of gravity (C.G.) directly on the center plate. Fill in the distance between body center of IMU/GPS and the C.G. of multi rotor in X, Y & Z axles as showed in the figure.

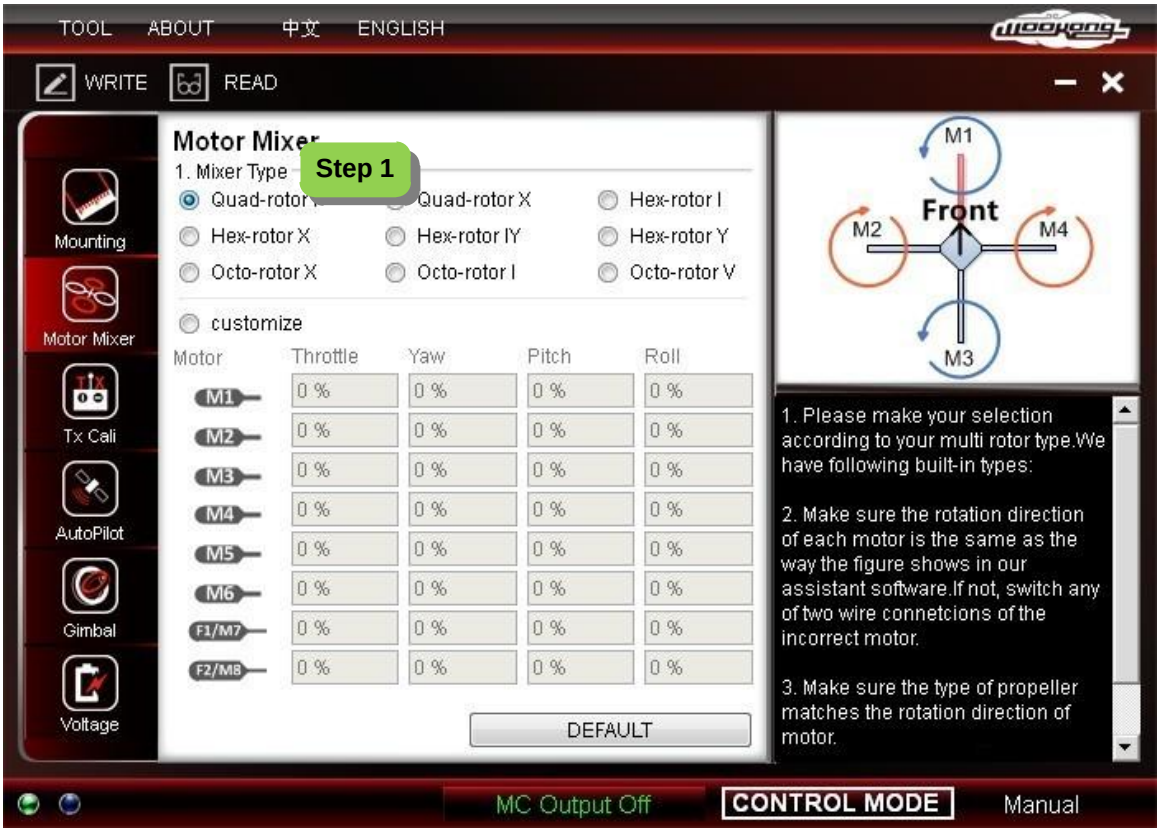
1 You must re-configure if the ALL-UP-WEIGHT had been changed on your multi rotor,

2 If mounting locations are not accurate enough or the sign were wrong, error on X, Y , Z axles will leads the oscillation of your multi rotor.

3 Make sure to follow the diagram in Assistant software: red is positive, green is negative; unit of measure is CM, NOT INCH.

2. Motor Mixer

For safety reasons, please disconnect ESCs and Power Connection Adapter or remove all propellers during configuration and system setup!

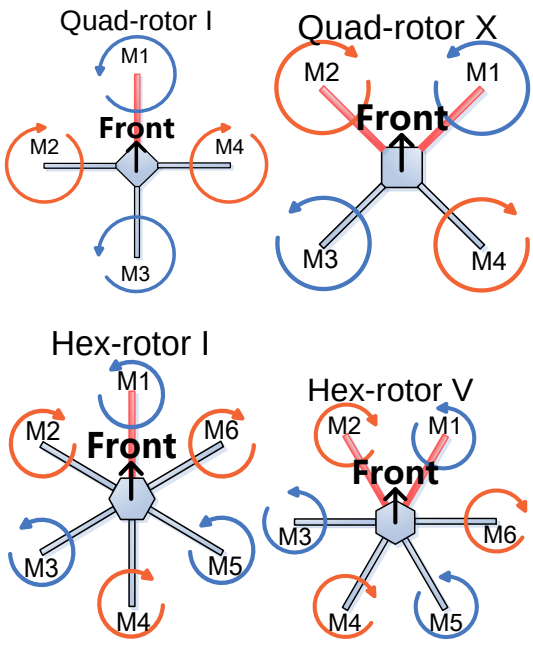


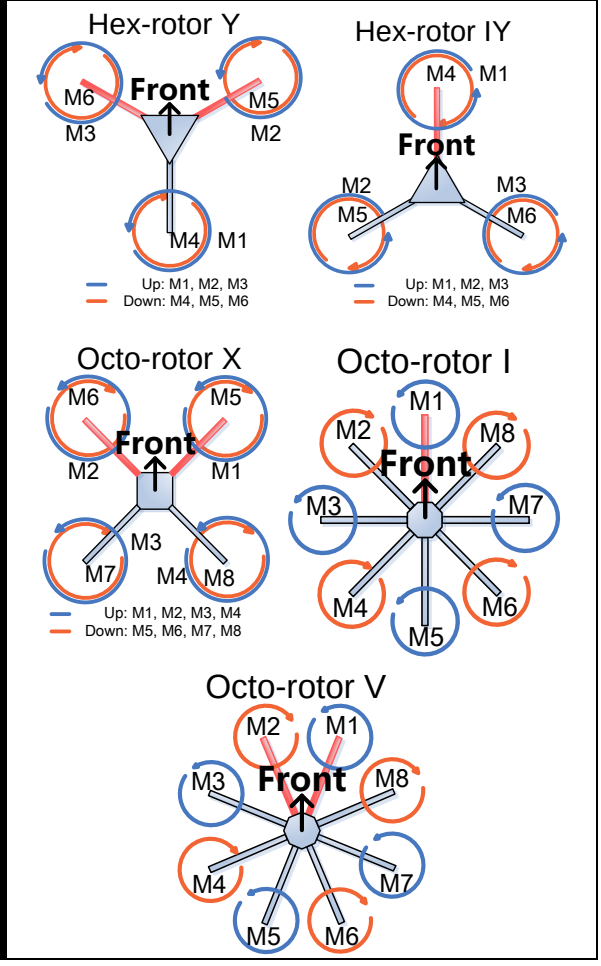
STEP1: ***Mixer Type***

1 Please make your selection according to your multi rotor type. We have following built-in types:

Do NOT follow instruction from your multi rotor manufacturer! Make sure the rotation direction of each rotor is the same as the way our figure shows

Build-in models:





2 Make sure the rotation direction of each motor is the same as the way the figure shows in our assistant

software. If not, switch any of two wire connetcions of the incorrect motor.

3 Make sure the type of propeller matches the rotation direction of motor.

4 You have to set your transmitter to ACROBATIC Mode.

If you want to use gimbal with an Octo-rotor, you have to use S-Bus receiver, then you can use port T and R for gimbal control. Otherwise, there will be no ports on MC for gimbal.

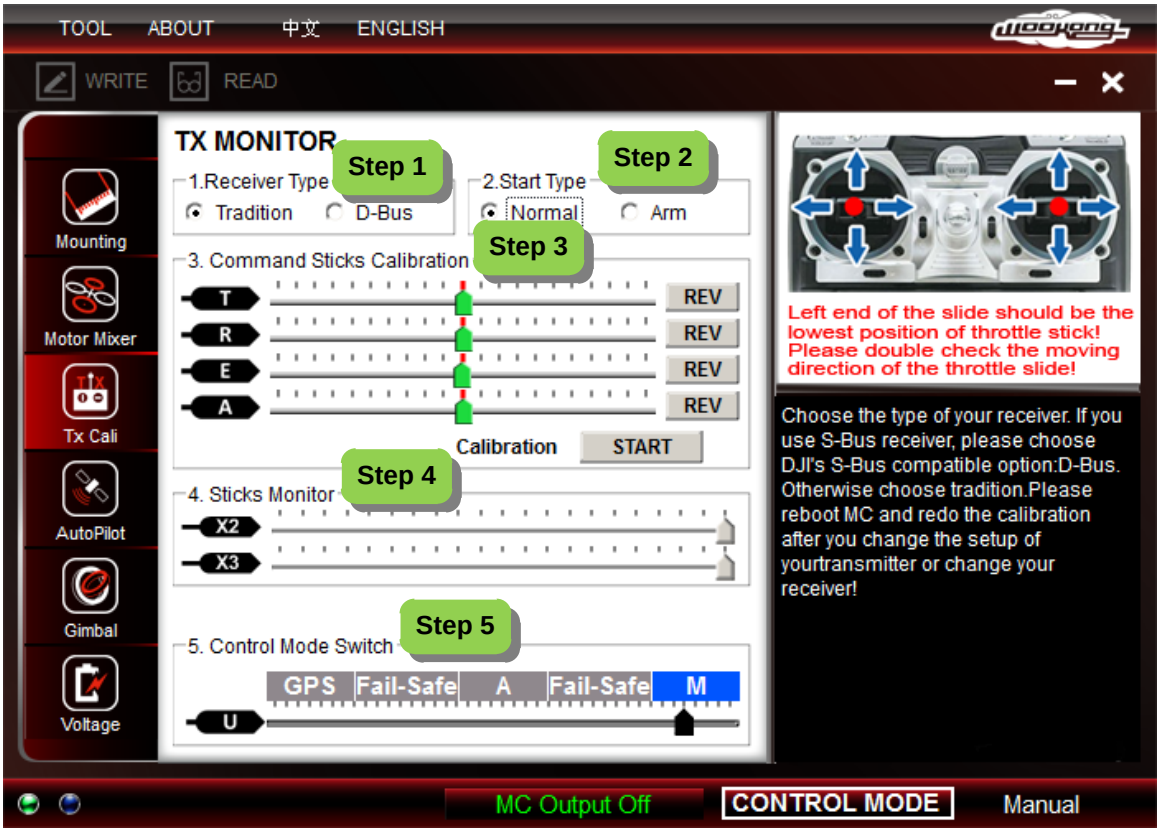
Customize

This segment is reserved only for very special case, such as customized airframe in non-conventional rotor arrangement. In the event, an airworthy multi-rotor craft with such rotor arrangement will require customized setting to meet WKM controller algorithm. Please write to our support department or contact together with photos of the multi-rotor for assistance.

Please refer to *Customize Motor Mixer* section in Appendix for how to customize a central symmetry multi rotor.

3. Tx Calibration

For safety reasons, please disconnect ESCs and Power Connection Adapter or remove all propellers during configuration and system setup!

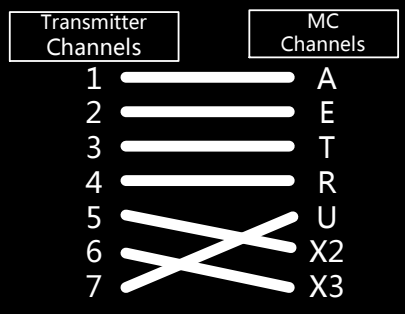


1. The transmitter you used must be Fail-Safe featured, which allows you to setup fixed outputs for U channel if the receiver lost signals, otherwise WKM will not enable the Fail-Safe.
2. All the channels in your transmitter should be working independently: NO CCPM, NO channel MIX.
3. You need at least one 2 or 3-position switch on your transmitter to be set as the control mode switch.

STEP1: Receiver Type

Choose the type of your receiver. If you use S-Bus receiver, please choose DJI's S-Bus compatible option: D-Bus. Otherwise choose tradition. Please reboot MC and redo the calibration after you change the setup of your transmitter or change your receiver!

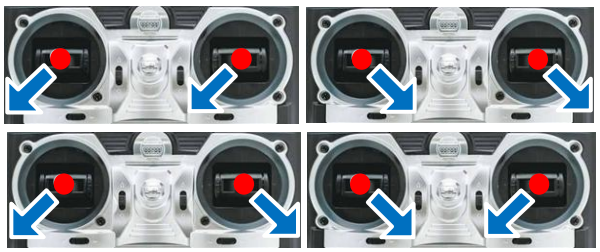
If you use S-Bus receiver, the communication of A, E, T, R, U, X1 and X2 channels are all through the D-Bus channel. Right figure shows the connection of default transmitter channels and MC channels in S-Bus receiver (Only first 8 channels of S-Bus receiver are used at the moment). Then the original T and R channels are for Gimbal servo control.



STEP2: Start Type

Choose a start type of motors: **Normal Mode** or **Arm Mode**. **Arm Mode** uses ***Start-Stop Control*** to start and stop of motors.

Start-Stop Control: In **Arm Mode**, you need to execute any one of following combination stick commands to start or stop motors.



Any one of these combination stick commands can change the state of motors. For example: you can execute  to start motors; after landing you can execute  to stop motors. Or execute  to start motors; after landing execute the same  to stop motors.

Normal Mode

	Manual Mode	Atti. / GPS Atti. Mode	
Start	Throttle stick over 10%.	Throttle stick over 10%.	
Stop	Throttle stick under 10%.	Throttle stick under 10%, and after landing 3 seconds.	The slope angle of multi-rotor is over 70°, and throttle stick under 10%.

Normal Mode hints:

1. In some cases, although throttle stick is already under 10%, and multi-rotor is already on the ground, motors are still working. This is because the vibration of multi-rotor affects the landing judgment. Therefore it is all right if motors fail to stop in time occasionally.
2. If multi-rotor lands in ***Atti.*** / ***GPS Atti. Mode***, and you want to stop motors immediately, you can switch to ***Manual Mode*** when you keep the throttle stick under 10%.
3. For safety reason, when the slope angle of multi-rotor is over 70° during the flight in ***Atti.*** / ***GPS Atti. Mode*** (may be caused by collision, motor and ESC error or propeller broken down), and throttle stick is under 10%, motors will stop automatically.
4. For safety reason, throttle stick under 10% will not stop motors during normal flight in ***Atti.*** / ***GPS Atti. Mode***.

Arm Mode

	Manual Mode	Atti. / GPS Atti. Mode		
Start	Execute ***Start-Stop Control***	Execute ***Start-Stop Control***, then push throttle stick over 10% in 3 seconds, otherwise motors will stop after 3 seconds.		
Stop	Execute ***Start-Stop Control***	Throttle stick under 10%, and after landing 3 seconds.	The slope angle of multi-rotor is over 70°, and Throttle stick under 10%.	Execute ***Start-Stop Control***

Arm Mode hints:

1. You have to execute ***Start-Stop Control*** to start motors. Push throttle stick only will not start motors.
2. In ***Atti.*** / ***GPS Atti. Mode***, it still has landing judgment, which will stop motors.
3. Start motors in ***Atti.*** / ***GPS Atti. Mode***, you have to execute ***Start-Stop Control***, and then push throttle stick over 10% in 3 seconds, otherwise motors will stop after 3 seconds.
4. During normal flight, only pull throttle stick under 10% will not stop motors in any control mode.
5. For safety reason, when the slope angle of multi-rotor is over 70° during the flight in ***Atti.*** / ***GPS Atti. Mode*** (may be caused by collision, motor and ESC error or propeller broken down), and throttle stick is under 10%, motors will stop automatically.
6. You can stop motors by executing ***Start-Stop Control*** in any control mode.

1. All these two start type will work properly only if Tx calibration is correct.
2. If you choose **Arm Mode**, motors will start or stop immediately when you execute ***Start-Stop Control***. It has nothing to do with current throttle stick position. Please DO NOT executes ***Start-Stop Control*** during flight without any reason.
3. If you choose **Arm Mode**, throttle stick under 10% will trigger landing judgment in any control mode. In this judgment, pitch, roll and yaw controls are denied except throttle, but multi-rotor will still auto level.
4. In any control mode, DO NOT pull throttle stick under 10% during normal flight without any reason.
5. In any auto action caused by failed-safe or low voltage protection (e.g. auto Go Home), any commands applied to start or stop motors are denied by MC, motors will hold state.

STEP3: Calibration

1. Set endpoints of all channels to default values (100%) and set all trims and sub-trims of sticks to 0 on your transmitter first. Keep all curves' settings as default since the end-point of transmitter sticks will be recorded here.

2. Click **[START]** button, and move all of the sticks throughout their complete range several times.

3. After that, click **[FINISH]** button when you finished above procedures.

All slides should be in "Green" when all the sticks are in the middle positions as showed in the top figure. If not, power down your Tx and MC, wait for 30s, and redo the same procedure.

Notice:

Throttle: Slide left is craft down, slide right is craft up;

Rudder: Slide left is nose left, slide right is nose right;

Elevator: Slide left is craft back, slide right is craft front;

Aileron: Slide left is craft left, slide right is craft right.

4. If the moving direction of the slide is opposite to the description above, click the reverse button **[REV]/[NORM]** beside.

If slides cannot go back to center points (turn green) when you redo the calibration, just click **[finish]**, then slides will be at center automatically.

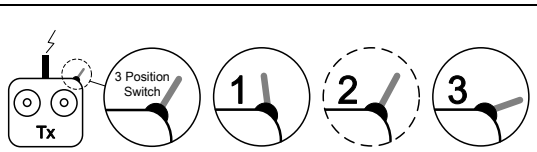
STEP4: Extra Control

This step is optional. X1 and X2 is for remote gain tuning; X1 is also for gimbal pitch control. Setup the channel on your RC correctly.

STEP5: Control Mode Switch

1. Whichever 2 or 3 positions switch/channel user has selected or decided to use in the transmitter (for control mode switching), in this case channel U marking on main controller. At each switch position, use sub-trim or end-point (+/-) fine tuning on your transmitter, move the slider of channel U to **GPS** (***GPS Atti Mode***), **A** (***Atti. Mode***), **M** (***Manual Mode***) to turn the corresponding area blue respectively as showed in the figure of last page.

Notice: *To move the slider is to adjust sub-trim or end-points of the channel selected.*



- **For 3-positions switch, you should assign:**

Position-1 to *Manual Mode*;

Position-2 to *Atti. Mode*;

Position-3 to *GPS Atti. Mode*;

Or reverse the assignment for ***Position-1*** and ***Position-3***.

- **For 2-positions switch, you can assign any two of these three control modes as you like.**

2. Move the slider to the range which reads **Fail-Safe MODE** to turn the area blue, set Fail-Safe output of receiver to input port-U. If you switch off your transmitter now, the U channel slide should move to **Fail-Safe MODE** and turn the corresponding area to blue. Otherwise please reset the fail-safe.

Please refer to your RC manual for the details of fail-safe setup.

1 Do NOT set the failed-safe position of throttle under 10% endpoint.

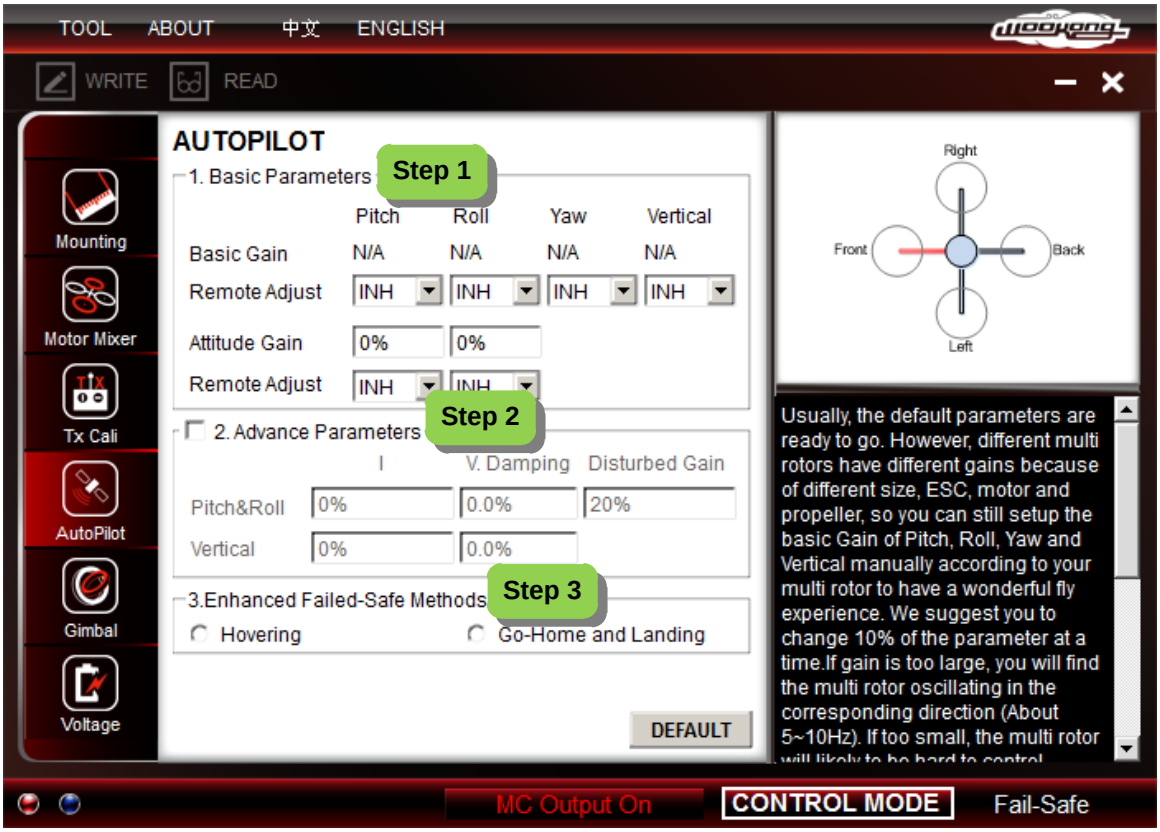
2 MC would not execute Fail-Safe protection if you don't set it properly. You can verify the Fail-Safe settings by shutting down your transmitter, and then you can use the following method to check whether MC is already in Fail-Safe mode.

- Check the Assistant Software status bar at the bottom side of the software interface. Control mode will change to Fail-Safe.

- Check the LED indicator. Read the appendix in this manual for details. LED will give blue blinking if in fail-safe mode.

4. Autopilot

For safety reasons, please disconnect ESCs and Power Connection Adapter or remove all propellers during configuration and system setup!



STEP1: ***Basic Parameters***

You must click [Default] button in first setup parameter, and subsequence firmware upgrade.

Usually, the default parameters are ready to go. However, different multi rotors have different gains because of different size, ESC, motor and propeller. If gain is too large, you will find the multi rotor oscillating in the corresponding direction (About 5~10Hz). If too small, the multi rotor will likely to be hard to control. So you can still setup the basic Gain of Pitch, Roll, Yaw and Vertical manually according to your multi rotor to have a wonderful fly experience. We suggest you to change 10% to 15% of the parameter at a time.

To the gains of Pitch and Roll, if you release the Pitch or Roll stick after command stick, multi-rotor should be back to hovering state. If the reaction of multi-rotor in this procedure is too soft (large delay), please increase the basic gain slowly (10%-15% each time) until vibration emerges after you release the stick. Then decrease the gain a little until vibration just disappears. Now the gain is perfect, but the reaction of the attitude change is slow. You can follow the way introduced at the end of this section to tune the attitude gains.

The way of tuning the Yaw gain is the same as the way of adjusting the Tail Gyro. If you want fast stick reaction speed, increase the gain, otherwise decrease the gain. However, the spin of multi-rotor is produced by the counter torque force, and the magnitude of which is limited. Therefore, large gain will not produce tail vibration like helicopter, but severe reaction at the start or stop of motors, which will affect the stabilization of the other directions.

You use two methods to judge if the Vertical gain is good enough: 1) The multi-rotor can lock the altitude when the throttle stick is at center position; 2) The change of altitude is small during the flight along a route. You can increase the gain slowly (10% each time) until the vibration emerges along the vertical direction or the reaction of throttle stick is too sensitive, then decrease 20% of the gain. Now it is a suitable Vertical gain.

Attitude gains determine the reaction speed of attitude from command stick, the bigger the value the quicker the reaction. Increase it for sharper and quicker leveling action after command stick released. The control feeling will be stiffness and rigid if the value is too high; and sluggish leveling action and slow braking if too small.

Notice: The vertical gain will NOT affect the manual

mode.

If you are a fresh player, you can tune the basic parameters first as following.

1 Increase the basic parameters 10% at a time so as to make your multi rotor hover or light oscillate after small angular command input.

2 Decrease the basic parameters until your multi rotor can just hover, then decrease 10% more.

If the basic parameters are far away from the proper value, the advanced parameters will not work.

Here you can make use of remote gain-tuning channels to tune the gains during the flight:

1 Followed the instructions in Mounting and Connection R/C System section to connect and setup correctly;

2 Choose the X2 or X3 channel in Remote Adjust for the gain you want to tune. One channel to one gain.

3 The range of remote tuning is from half current value to twice current value.

Usually the Pitch, Roll, Attitude Pitch and Attitude Roll Gains of hex-rotor are high then quad-rotor.

STEP2: ***Advanced Parameters***

Usually you can ignore this step. The default values are suitable for most of the conditions, so we do NOT recommend you to change the parameters here. To some special multi rotor, experienced user can adjust the advanced parameters to have a better fly experience.

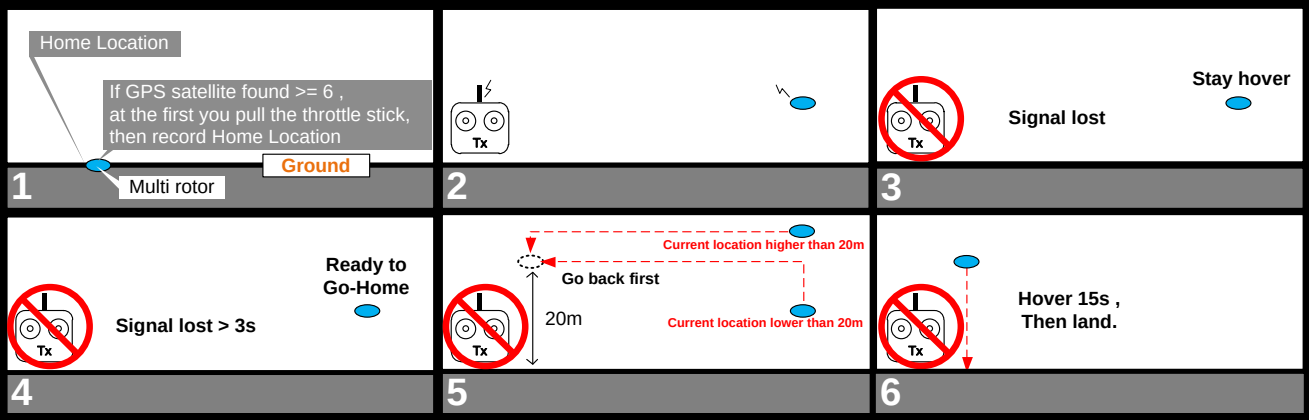
STEP3: Enhanced Failed-Safe Methods

Choose one method for your failed-safe function, and the method will be triggered when MC loses the control signal. This could be one of the following situations:

1) Signal lost between transmitter and receiver, e.g. multi-rotor is out of the communication range, or transmitter is down, and so on.
2) One or more connections of A, E, T, R, U channels between MC and receiver loses. If this happens before take-off, motors will not work if you push the throttle stick; if this happens during the flight, LED blue light will flash to warn in addition to the failed-safe method. If Hovering failed-safe method is triggered and U channel is disconnected, multi-rotor will auto land.

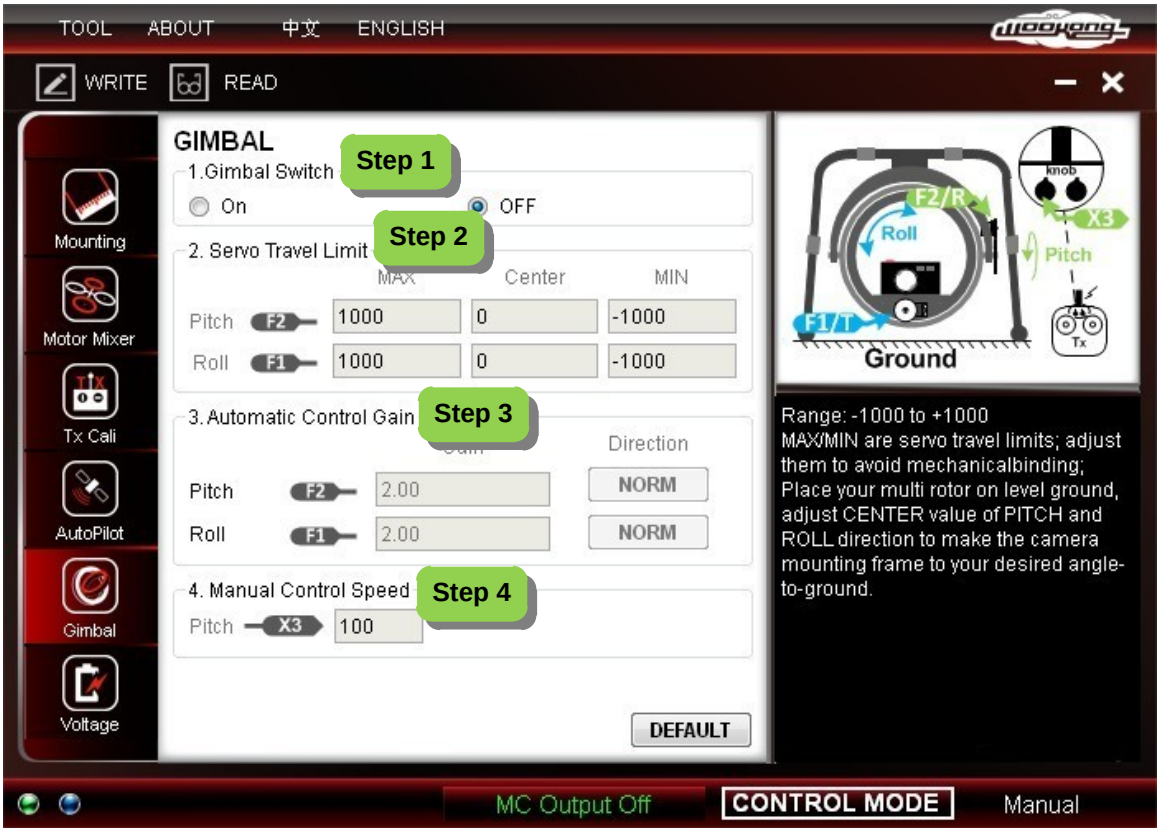
Here the home point is the position saved by the MC automatically when 6 or more GPS satellites are found (red light blinks once or no blinking) and the first time you push the throttle stick. When switch to ***Manual*** or ***Atti. Mode***, MC will disengage enhanced failed-safe mode, you can re-gain control of multi rotor.

The following schematic shown is introduction for Go-Home and Landing.



5. Gimbal

For safety reasons, please disconnect ESCs and Power Connection Adapter or remove all propellers during configuration and system setup!



STEP1: ***Gimbal switch***

If you use gimbal, please choose ***On*** here.

If you open the gimbal control in assistant software during the configuration, please note that there is output from F1 and F2 ports. Now you should not connect these ports to ESCs which is wired with propellers equipped motors.

If you want to use gimbal with an Octo-rotor, you have to use S-Bus receiver, then you can use port T and R for gimbal control. Otherwise, there will be no ports on MC for gimbal.

STEP2: ***Servo travel limit***

Range: -1000 to+1000

MAX/MIN are servo travel limits; adjust them to avoid mechanical binding; Place your multi rotor on level ground, adjust **CENTER** value of **PITCH** and **ROLL** direction to make the camera mounting frame to your desired angle-to-ground.

STEP3: ***Automatic control gain***

Range: 0 to 100

Adjust the reaction angle of automatic control. The initial value 100 is full angle. The bigger the gain the bigger the reaction angle. Click **[REV]/[NORM]** button, and then you can reverse the feedback control directions.

STEP4: ***Manual Control Speed***

Range: 0 to 100

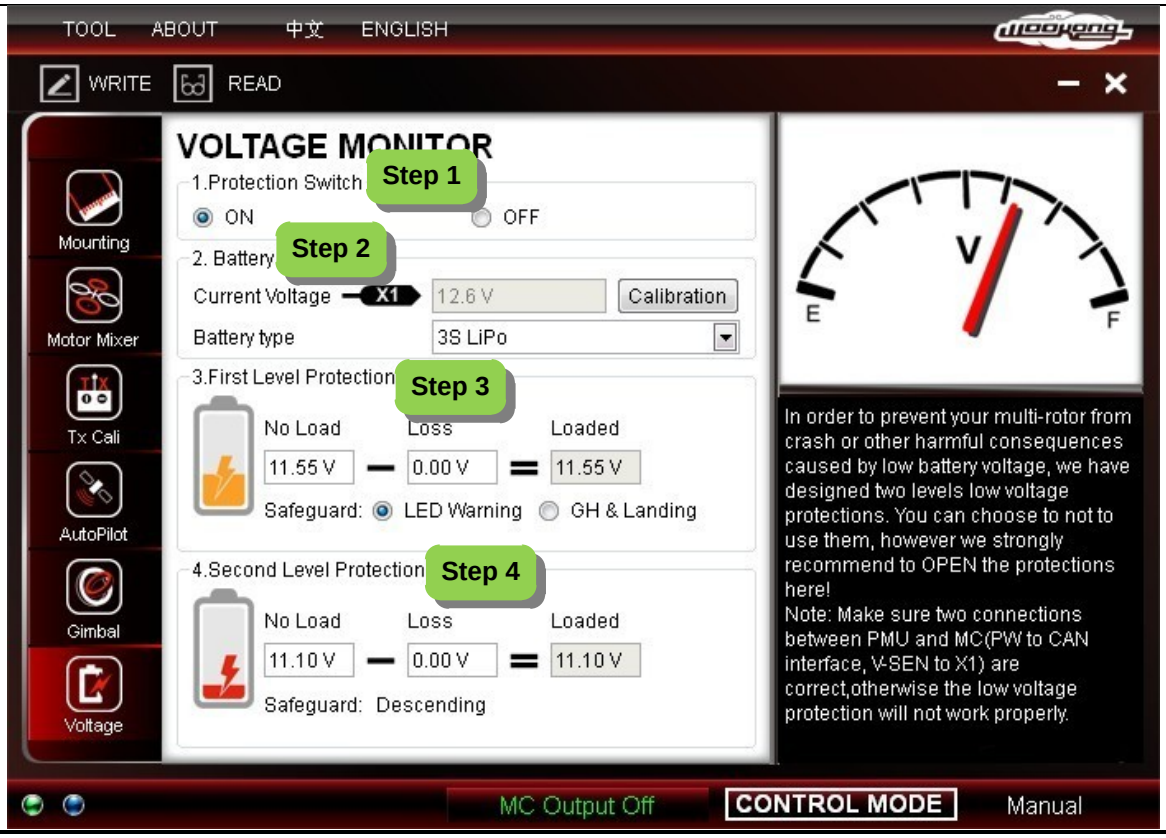
1 You should assign one of the knobs on your transmitter to X3 channel for controlling the Pitch direction (angle) of camera gimbal during flight first.

2 Adjust the reaction speed of pitch direction manual control; the initial value 100 is full speed.

You should assign one of the knobs on your transmitter to X3 channel for controlling the Pitch direction (angle) of camera gimbal during flight. If parameter adjustment was enabled on channel X3, the gimbal manual control via channel X3 will not be force to disabled.

6. Voltage Monitoring

For safety reasons, please disconnect ESCs and Power Connection Adapter or remove all propellers during configuration and system setup!



STEP1: *Protection Switch*

In order to prevent your multi-rotor from crash or other harmful consequences caused by low battery voltage, we have designed two levels low voltage protections. You can choose to not to use them, however we strongly recommend to OPEN the protections here!

Note: Make sure two connections between PMU and MC (PW to CAN interface, V-SEN to X1) are correct, otherwise the low voltage protection will not work properly.

1 All two level protections have LED warning as default. First level will blink yellow light ● ceaselessly; second level will blink red light ● ceaselessly.

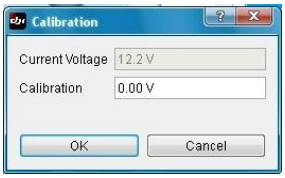
2 All two level protections will only have LED warning under ***Manual Mode***, no any automatic actions.

3 Low voltage protections are NOT fun! You should land your multi-rotor ASAP in any level of protection to prevent your multi-rotor from crash or other harmful consequences!

STEP2: *Battery*

Power the MC by a battery and connect the MC with PC, current battery voltage will be displayed in this column.

1 If the battery voltage displayed here is different from the voltage you measure from a voltmeter, you have to calibrate. Click the **[Calibration]**, fill the voltage you have just measured in the Calibration column of the dialogue box, and then click **[Confirm].**



2 Meanwhile we need you to choose the battery type you are using, so that MC can provide default warning voltages and ranges of warning voltages for you.

STEP3: *First Level Protection*

Explanation of nouns:

- No Load (No Load Voltage): Self-defining warning voltage. Needs your input.
- Loss (Line Loss Voltage): The battery voltage drop during the flight. Needs your input.
- Loaded (Loaded Voltage): The real-time battery voltage during the flight. This is the actual warning voltage monitored by MC. No needs your input, calculated by No Load and Loss.

■ ***Voltages Magnitude Relation***

1 No Load: First level > Second level.

2 Loss: First level = Second level.

3 Loaded: Calculated, First level > Second level.

■ ***Method of Acquiring Line Loss Voltage：***

1 Make sure you can fly your multi-rotor normally with a fully charged battery.

2 Use a fully charged battery, switch on the low voltage protections in assistant software, and observe the current voltage. Fill a reasonable warning voltage in the No Load of first protection (We recommend to fill a voltage 1V lower than current voltage and higher than minimum battery voltage rating in). Fill 0V in Loss at the moment.

3 Fly the multi-rotor until the first level protection is triggered, and the yellow light is flashing. Now land your multi-rotor ASAP.

4 Connect the MC to PC, open the assistant and acquire now current voltage. The Loss (Line loss voltage) is the difference between the new current voltage and the first level No Load voltage you filled in.

1 If the line loss voltage of a battery is over 0.3V per cell (e.g. 3S battery over 0.9V), it's because the internal resistance of battery is high or the battery is too old, we suggest you to replace it!

2 Generally the line loss voltage of different battery is different. For the consideration of safety, you'd better acquire all the line loss voltages of all your battery you are using, and fill the lowest one in the Loss.

3 When you change the payload or multi-rotor, you have to get new line loss voltage.

4 The line loss voltage will be bigger after many times use, you should get new one after 30 times charging.

5 Make sure your ESCs protection voltage is lower than 3.1V (1S), otherwise WKM low voltage protection will not work.

1 Acquire the line loss voltage by the method introduced before first, and fill it in Loss.

2 Fill a reasonable warning voltage in the No Load.

3 Choose a safeguard: 1) LED warning: It is the default safeguard when you switch on the low voltage protection; 2) Go Home and Landing: This safeguard will NOT be triggered when any of the following items is satisfied:

a) ***Manual*** or ***Atti. Mode***;

b) GPS signal is not good;

c) The distance between Home Location and multi-rotor is smaller than 25m, and the altitude is smaller than 20m relative to Home Location. Here the generation of Home Location is the same as the way used in Enhanced Failed-safe. Please refer to Enhanced Failed-safe in Autopilot.

1 There will be a 4 seconds LED warning before Go Home.

2 If you switch to ***Manual*** or ***Atti. Mode*** during Go Home, you will regain the control. LED warning will be still on, please land ASAP.

3 If you switch back into the ***GPS Mode*** when you are in first level protection, you will have 15s time to control your multi-rotor, you should land ASAP in this 15s to prevent your multi-rotor from crash or other harmful consequences! After that if the Go Home and landing requirements are satisfied, multi-rotor will Go Home and Landing automatically.

4 If you choose LED warning, please land ASAP after LED warning to prevent your multi-rotor from crash or other harmful consequences!

5 Compare the Go Home and Landing of low voltage protection and the Go Home and Landing in Enhanced Failed-safe, the generations of Home Location are the same; the Go Home routes are the same; the difference is that there is no hovering before landing in low voltage protection.

STEP4: ***Second Level Protection***

1 Fill the warning voltage and line loss voltage in No Load and Loss by the method introduced in previous step.

2 When the second level protection is triggered, LED warning will be on. Meanwhile the center point of throttle stick will move up slowly to 90% of endpoint, you should land ASAP to prevent your multi-rotor from crash or other harmful consequences!

3 When the center point is at 90% of endpoint, multi-rotor will still ascend slowly if you continue to pull the throttle stick, and the control of Pitch, Roll and Yaw are the same as before. Please land ASAP to prevent your multi-rotor from crash or other harmful consequences!

If your multi-rotor goes into the second level protection during Go Home in first level protection, it will land immediately. If you switch into Manual or Atti. Mode, you will regain the control, and the center point of throttle stick will move up slowly to 90% of endpoint. Please land ASAP to prevent your multi-rotor from crash or other harmful consequences!

Flight

1. Digital Compass Calibration

■ *Why calibrate the compass?*

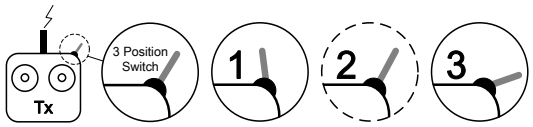
Ferromagnetic substances placed on multi rotor or around its working environment will affect the reading of earth magnetic for digital compass, it also reduces the accuracy of the multi rotor control, or even reads incorrect heading. Calibration will eliminate such influences, and ensure MC system performs well in a non-ideal magnetic environment.

■ *When to do it?*

1. The first time you install WKM on your multi rotor.
2. When the multi rotor mechanical setup is changed:
   a) If the GPS/Compass module is re-positioned.
   b) If electronic devices are added/removed/ re-positioned (Main Controller, servos, batteries, etc).
   c) When the mechanical structure of the multi rotor is changed.
3. If the flight direction appears to be shifting (meaning the multi rotor doesn't "fly straight").
4. The LED indicator often indicates abnormality blinking when the multi rotor yaws. (It is normal for this to happen only occasionally.)

1. Don't calibrate your compass where there is strong magnetic interference, such as magnetite, car park, and steel reinforcement under the ground.
2. DO NOT carry ferromagnetic materials with you during calibration, such as keys or cell phones.
3. You don't need to rotate your multi rotor on a precise horizontal or vertical surface, but keep at least 45° difference between horizontal and vertical calibration.
4. MC cannot be work in the polar circle.

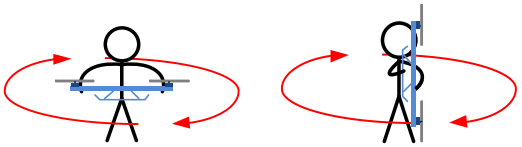
■ *Calibration procedure:*



STEP1: Enter calibration mode: quickly slide the control mode switch from ***Position-1***to ***Position-3*** for 6 to 10 times, and LED indicator will be constantly on in blue;

STEP2: Calibration in horizontal: rotate you multi rotor along with the horizontal surface until the green light is on constantly, then go to the next step;

STEP3: Calibration in vertical: while green light is constantly on, hold your multi rotor vertically and rotate it along with its vertical axis, keep rotating until the green light is off, meaning the calibration is finished.



STEP4: After you finished the calibration, LED indicator will show whether the calibration was successful or not:

- If white light turns on for 3 seconds, calibration succeeds, calibration mode will **auto exit**;
- If red light keeps blinking quickly, the calibration has failed. Slide the control mode switch one time to cancel current calibration, and then re-start from step 1 for re-calibration.

If you keep having calibration failure, it might suggest that there is very strong magnetic interference around the GPS & Compass module, please avoid flying in this area.

2. Fly Cautions

Make sure you have read the following cautions before the flight.

- Make sure you have assembled your multi rotor correctly.
- Make sure you have done the configuration procedure correctly.
- Any of the following mistakes will leads to dangerous accident, double check all these items:
  - ■ Rotation direction of motor is opposite;
  - ■ Propeller installation mistake;
  - ■ IMU installation mistake;
  - ■ Wrong connection between MC and ESC;
  - ■ Input direction opposite.
- In ***Atti*** and ***GPS Atti mode***, throttle stick center position is for 0m/s on the vertical direction. If you pull the stick to the bottom during the flight, multi-rotor will descend; If you pull the stick to the bottom on the ground, it will cut motors in 3 seconds. However the slow spinning of motors will affect the flight performance, you'd better keep throttle stick position higher than 10% from cut-throttle during the flight! In ***Manual Mode*** it will cut motors when pull throttle stick under 10%.
- Make sure switch on the transmitter first, then power on multi-rotor! (Power off multi-rotor first, then switch off the transmitter after landing!)

3. Test Fly

Please does the test fly and gain tuning with ***Atti. Mode*** in the open air without heavy wind! Please refer to the first step of ***Autopilot*** in ***Configuration Procedure*** for the gain tuning.

STEP1: Make sure your batteries are fully charged for your transmitter, MC and all the devices on your multi rotor;

STEP2: Check all connections and wirings, and make sure they are in good condition;

STEP3: Switch on the transmitter first, then power on your multi-rotor!

STEP4: Slide the control mode switch on your transmitter, and make sure it is working properly. Check it with LED indicator to specify the current working mode for MC. See Appendix for details about LED indicator;

STEP5: Switch the system to ***Atti.*** Mode. **Use any SAFE method to do the following test:** Apply the throttle to 20% slowly and make sure all the motors are working, and then try to push your sticks lightly in Roll, Pitch and Yaw to feel if your multi rotor moves to the corresponding direction. If not, go back to **Configuration Procedure** correct your settings.

STEP6: Push the throttle stick slowly until all the rotors are working, and then take-off your multi rotor gently

After a successful test fly, the preparation before taking off can be simplified: Put your multi rotor on the plane ground, turn on the transmitter first, power on multi rotor, when the red light starts to blink normally, you can take off in ***Atti. Mode***.

4. Fly with GPS

After the test fly, you can choose to use ***GPS Atti. Mode*** after reading the following notice:

When system is powered on, you must not move your multi rotor or sticks on transmitter until the system initialization is finished (about 5 second).

Please read this section before you switched to *GPS Atti. Mode*

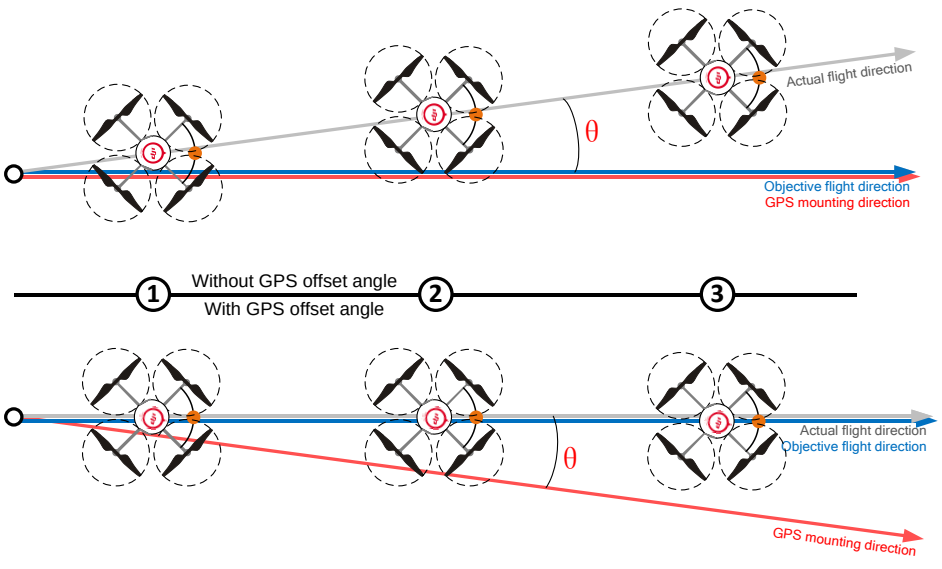
1 Make sure the GPS signal is good, without red LED blinking. Otherwise multi rotor will drift without stick commands.

2 Please avoid using MC system in the following areas, where will GPS signal is most likely blocked:

- Urban area with crowded buildings
- Tunnels
- Under bridges

Others system failures and errors will also be display by LED indicator. Read Appendix for details.

Should you find the multi-rotor does not track straight in forward flight, you might try re-mounting GPS in an offsetting angle as showed in right figure. Θ in the figure is the offsetting angle.



5. Quick LED Guide

Read **LED Indicator description** in **Appendix** for the full details.

, or no light indicates control mode.	No light indicates ***Manual*** Mode. (You can ignore GPS indication.)	indicates ***ATTI.*** mode. (You can ignore GPS indication.)	indicates ***GPS ATTI.*** mode.
indicates the number of GPS satellites	Blinks three times indicate 4 GPS satellites are found. DO NOT take off.		
	Blinks twice indicate 5 GPS satellites are found. Ready to go, but fly performance is not good.		
	Blinks once indicate 6 GPS satellites are found. Ready to go, but fly performance is not good.		
	No blink indicates GPS is good. Ready to go.		

Maintains

Firmware Upgrade

Please strictly follow the operation procedure for firmware upgrade, otherwise WKM might not work properly:

1. Make sure your computer is connected to the Internet.
2. Please close all the other applications during the firmware upgrade, including Anti-virus software and firewall.
3. Make sure the power supply is securely connected. DO NOT un-plug the power supply until firmware upgrade has finished.
4. Connect MC to PC with micro-USB cable, DO NOT break connection until firmware upgrade is finished.
5. Run Software and wait for connection.
6. Select **[TOOL]→[Firmware Upgrade]**.
7. DJI server will check your current firmware version, and get the latest firmware prepared for the unit.
8. If there is a firmware version more up-to-date than your current version, you will be able to click the upgrade button.
9. Wait until Assistant software reads “Finished”.
10. Please power cycle the unit after at least 5 seconds.
11. Your unit is up-to-date now.

- After firmware upgrade, please re-configure WKM using Assistant software.
- If it is notified that the network or DJI server is busy, please try again later with above procedures.
- If firmware upgrade failed, WKM will enter **<waiting for firmware upgrade status>** automatically, please try again with the above procedures.

Note: You will be asked to fill out contact information/register as user prior to any upgrades

Product Info

You can check the MC product version via **[ABOUT]→[Info]**.

- Software version
- Firmware version
- IMU version
- Hardware ID

[S/N] is a 32 digits authorization code for unit function activations. We had already filled in the authorization code for your unit after manufacture. You might be asking to fill in the new **[S/N]** in the future if you brought new function upgrades.

Fill-in the **[S/N]** and then click **[Write]** button.

If you filled in the invalid S/N over 30 times, your MC will be locked and you have to contact our customer support.

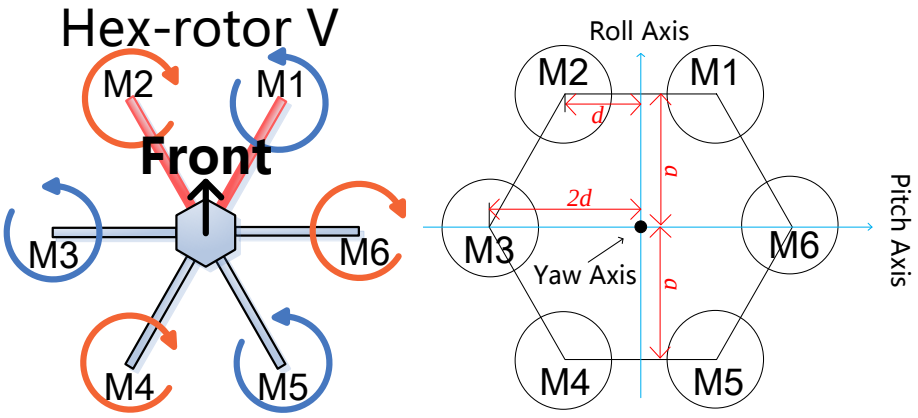
Appendix

Customize Motor Mixer

For a multi rotor, the roll, pitch, yaw and vertical axes are contributed by the combination of rotors' outputs. This procedure is called Mix Control. The proportion of rotors' outputs is decided by the mechanical structure. Customers can setup the motor output coefficients C in **[Motor Mixer]** → **[Customize]** so as to realize the Mix Control.

■ *Before customization, you should have the important knowledge following:*

1. Motor output = C ×Stick position (A or E or T or R).
   Torque produced by motor = Motor output ×Force arm of motor (L) = C ×Stick position (A or E or T or R) ×L
2. The range of C is from -100% to 100%. Maximum C in the same column is 100%. The bigger absolute value of C, The great effect of stick position on motor output. Stick position will not affect motor output when C is 0, which means the motor output is fixed.
3. Each motor has four different output coefficients: C_T, C_Y, C_P, C_R. E.g. C_{Y2} represents coefficient of M2 in yaw control; C_{R5} represents coefficient of M5 in roll control.
4. Motor output is relative to its rotation speed. The bigger output, the faster rotation speed. Negative output does not represent counter rotation, but slower rotation speed. Motor is still spinning if its output is 0.
5. Throttle stick position (T): Pull stick T<0, multi-rotor moves down; Push stuck T>0 multi-rotor moves up;
   Rudder stick position (R): Stick left R<0, multi-rotor nose left; Stick right R>0, multi-rotor nose right;
   Elevator stick position (E): Pull stick E<0 multi-rotor moves backward; Push stuck E>0, multi-rotor moves forward;
   Aileron stick position (A): Stick left A<0, multi-rotor moves left; Stick right A>0, multi-rotor moves right.
6. Multi-rotor should keep balance along all the other axes when moves along one axis:
   - To keep throttle direction balance, sum of all motors' output should be 0 when apply rudder or pitch or roll stick command;
   - To keep yaw direction balance, sum of counter clockwise motors' output should be equal to sum of clockwise motors' output when apply throttle or pitch or roll stick command;
   - To keep pitch direction balance, total torques produced by motors at each side of pitch axis should be the same when apply throttle or rudder or roll stick command;
   - To keep roll direction balance, total torques produced by motors at each side of roll axis should be the same when apply throttle or rudder or pitch stick command。
7. To pitch or roll control, proportion of coefficients of the motors at the same side of pitch or roll axis should be equal to the proportion of force arms of those motors: $C_m/C_n = L_m/L_n$; Coefficient is 0% if the force arm of that motor is 0.



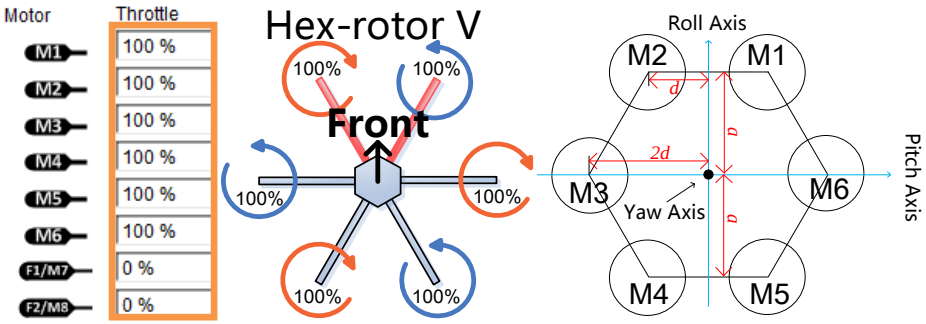
Now we take the Hex-rotor V as an illustration to introduce how to customize motor mixer.

■ *Throttle*

Usually, we want push the throttle stick to ascend the multi-rotor; pull the throttle stick to descend the multi-rotor; put the throttle stick at center point to hover the multi-rotor. We also want multi-rotor to keep balance along all the other axes when apply the throttle stick command:

$$\begin{cases} (C_{T1} + C_{T3} + C_{T5}) \times T = (C_{T2} + C_{T4} + C_{T6}) \times T \quad (\text{To keep yaw direction balance}) \\ (C_{T1} + C_{T2}) \times T \times a = (C_{T4} + C_{T5}) \times T \times a \quad (\text{To keep pitch direction balance}) \\ (C_{T2} + C_{T4} + 2C_{T3}) \times T \times d = (C_{T1} + C_{T5} + 2C_{T6}) \times T \times d \quad (\text{To keep roll direction balance}) \end{cases} \quad 1$$

As we defined before: Pull stick T<0, multi-rotor moves down; Push stuck T>0 multi-rotor moves up, we can choose the following setup:



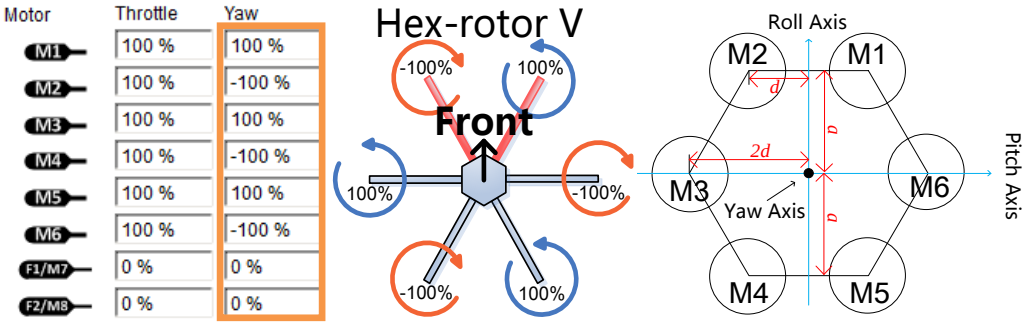
Now if push the throttle stick, the sum of all motors output ($C_{T1} + C_{T2} + C_{T3} + C_{T4} + C_{T5} + C_{T6}$)×T is positive, then multi-rotor moves up; pull the throttle stick, the sum of all motors output ($C_{T1} + C_{T2} + C_{T3} + C_{T4} + C_{T5} + C_{T6}$)×T is negative, then multi-rotor moves down. And the balance along all the other axes can be derived by substituting the throttle stick command into equations set 1.

■ *Yaw*

The movement about yaw axis is produced by the counter torque force from the rotation of propeller. In our example, M1 M3 M5 produce clockwise torque force; M2 M4 M6 produce counter clockwise torque force. When the quad-rotor is hovering, all the rotors are spinning at the same angular velocity, which means the clockwise torque force equals to counter clockwise torque force, and this produces exactly 0 angular acceleration about yaw axis. Therefore, when the rotate speed of M1 M3 M5 is larger than M2 M4 M6, hex-rotor spins clockwise; when the rotate speed of M1 M3 M5 is smaller than M2 M4 M6, hex-rotor spins counter clockwise. We also want multi-rotor to keep balance along all the other axes when apply the yaw stick command:

$$\begin{cases} (C_{R1} + C_{R2} + C_{R3} + C_{R4} + C_{R5} + C_{R6}) \times R = 0 \quad (\text{To keep throttle direction balance}) \\ (C_{R1} + C_{R2}) \times R \times a = (C_{R4} + C_{R5}) \times R \times a \quad (\text{To keep pitch direction balance}) \\ (C_{R2} + C_{R4} + 2C_{R3}) \times R \times d = (C_{R1} + C_{R5} + 2C_{R6}) \times R \times d \quad (\text{To keep roll direction balance}) \end{cases} \quad 2$$

As we defined before: Stick left R<0, multi-rotor nose left; Stick right R>0, multi-rotor nose right, we can choose the following setup:



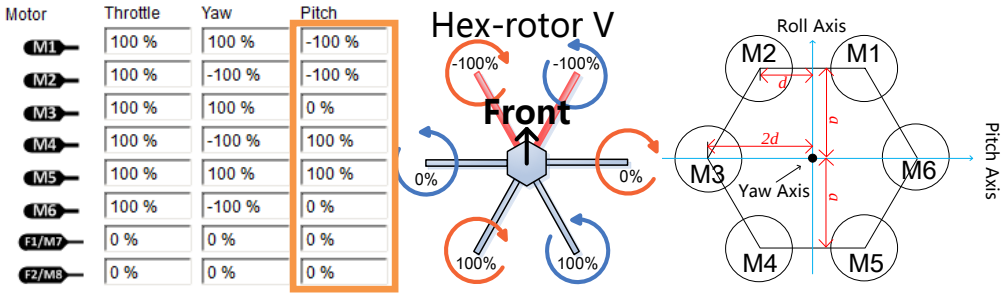
Now if move the yaw stick right, the sum of M1, M3, M5 output ($C_{R1} + C_{R3} + C_{R5}$) ×R is positive, the sum of M2, M4, M6 output ($C_{R2} + C_{R4} + C_{R6}$) ×R is negative, then the clockwise torque force is larger than counter clockwise torque force, multi-rotor nose right; if move the yaw stick left, the sum of M1, M3, M5 output ($C_{R1} + C_{R3} + C_{R5}$) ×R is negative, the sum of M2, M4, M6 output ($C_{R2} + C_{R4} + C_{R6}$) ×R is positive, then the clockwise torque force is smaller than counter clockwise torque force, multi-rotor nose left. And the balance along all the other axes can be derived by substituting the yaw stick command into equations set 2.

■ *Pitch*

The movement about the pitch axis is produced by the differential output of M1+M2 and M4+M5. Since M3 and M6 are on the pitch axis, they do not contribute and torque. You can just keep the rotation speed of M3 and M6 the same as hovering, so C_{P3} and C_{P6} are 0. Increase output of M4, M5 and decrease output of M1, M2, multi-rotor moves forward; decrease output of M4, M5 and increase output of M1, M2, multi-rotor moves backward. We also want multi-rotor to keep balance along all the other axes when apply the pitch stick command:

$$\begin{cases} (C_{E1} + C_{E2} + C_{E3} + C_{E4} + C_{E5} + C_{E6}) \times E = 0 \ (\text{To keep throttle direction balance}) \\ (C_{E1} + C_{E3} + C_{E5}) \times E = (C_{E2} + C_{E4} + C_{E6}) \times E \ (\text{To keep yaw direction balance}) \\ (C_{E2} + C_{E4} + 2C_{E3}) \times E \times d = (C_{E1} + C_{E5} + 2C_{E6}) \times E \times d \ (\text{To keep roll direction balance}) \end{cases} \quad 3$$

Also proportion of coefficients of the motors at the same side of pitch axis should be equal to the proportion of force arms of those motors: $C_{E1} : C_{E2} = C_{E4} : C_{E5} = a : a = 1 : 1$. As we defined before: Pull stick E<0 multi-rotor moves backward; Push stuck E>0, multi-rotor moves forward, we can choose the following setup:



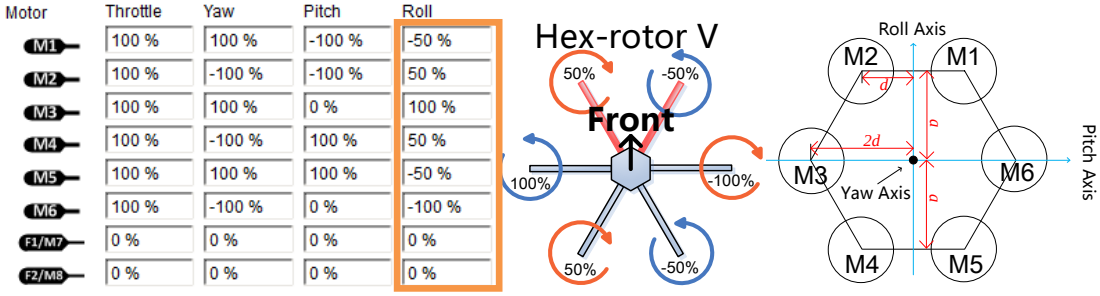
Now if push the pitch stick, the sum of M1, M2 output ($C_{E1} + C_{E2}$) ×E is negative, the sum of M4, M5 output ($C_{E4} + C_{E5}$) ×E is positive, then multi-rotor moves forward; if pull the pitch stick, the sum of M1, M2 output ($C_{E1} + C_{E2}$) ×E is positive, the sum of M4, M5 output ($C_{E4} + C_{E5}$) ×E is negative, then multi-rotor moves backward. And the balance along all the other axes can be derived by substituting the pitch stick command into equations set 3.

■ *Roll*

The theory of movement about the roll axis is the same with pitch axis. However there is no motor on the axis in this case, no coefficient is 0%. We also want multi-rotor to keep balance along all the other axes when apply the roll stick command:

$$\begin{cases} (C_{A1} + C_{A2} + C_{A3} + C_{A4} + C_{A5} + C_{A6}) \times A = 0 \ (\text{To keep throttle direction balance}) \\ (C_{A1} + C_{A3} + C_{A5}) \times A = (C_{A2} + C_{A4} + C_{A6}) \times A \ (\text{To keep yaw direction balance}) \\ (C_{A1} + C_{A2}) \times A \times a = (C_{A4} + C_{A5}) \times A \times a \ (\text{To keep pitch direction balance}) \end{cases} \quad 4$$

Also proportion of coefficients of the motors at the same side of roll axis should be equal to the proportion of force arms of those motors: $C_{E2} : C_{E3} : C_{E4} = C_{E1} : C_{E6} : C_{E5} = d : 2d : d = 1 : 2 : 1$. As we defined before: Stick left A<0, multi-rotor moves left; Stick right A>0 multi-rotor moves right, we can choose the following setup:

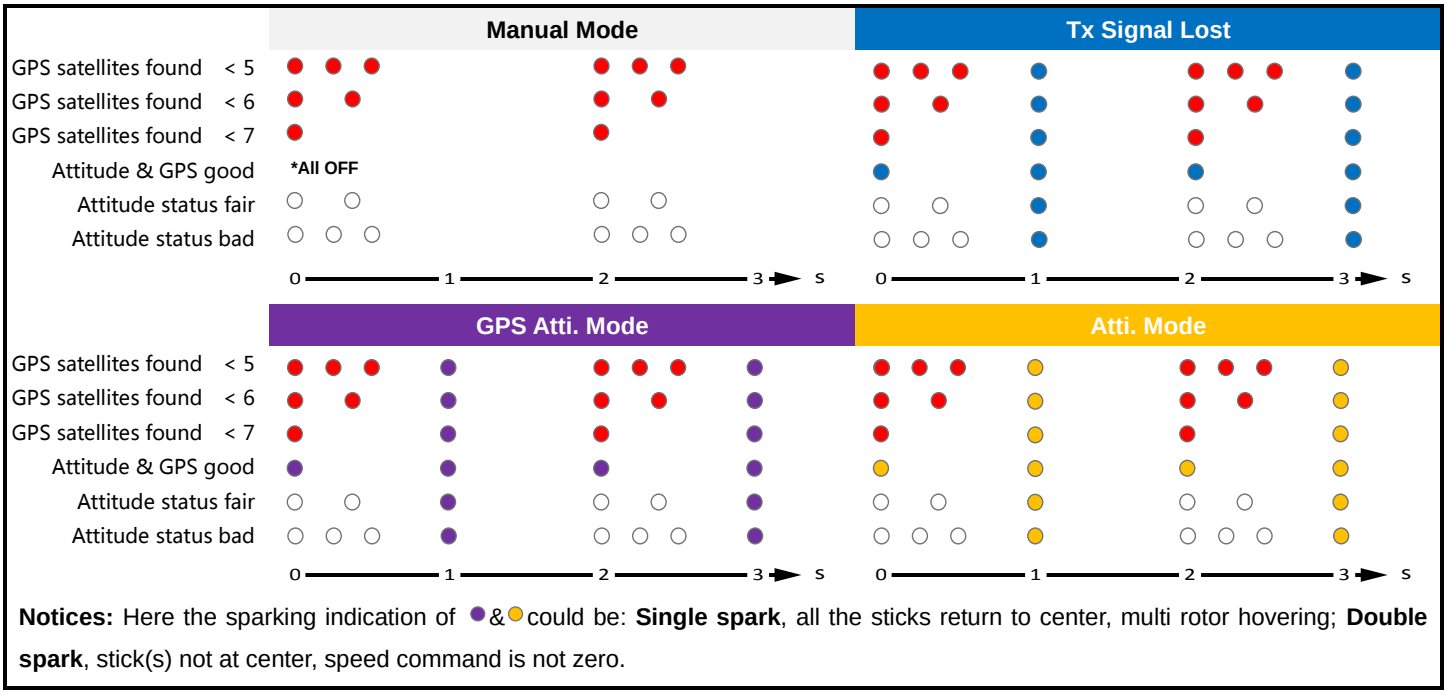


Now if move the roll stick right, the sum of M2, M3, M4 output ($C_{A2} + C_{A4} + 2C_{A3}$) ×A is positive, the sum of M1, M5, M6 output ($C_{A1} + C_{A5} + 2C_{A6}$) ×A is negative, then multi-rotor moves right; if move the roll stick left, the sum of M2, M3, M4 output ($C_{A2} + C_{A4} + 2C_{A3}$) ×A is negative, the sum of M1, M5, M6 output ($C_{A1} + C_{A5} + 2C_{A6}$) ×A is positive, then multi-rotor moves left. And the balance along all the other axes can be derived by substituting the roll stick command into equations set 4.

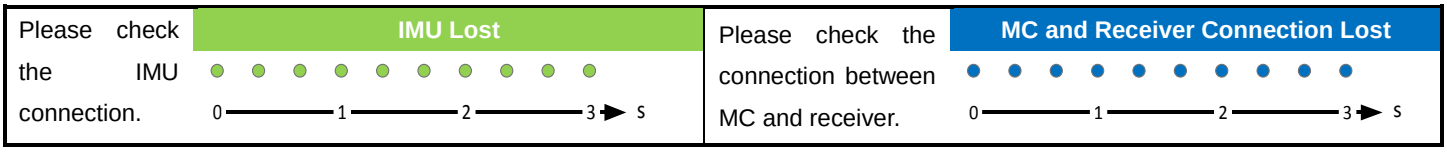
■ *Summary*

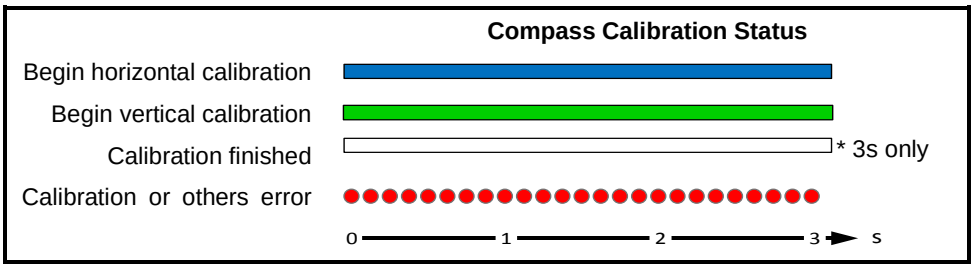
1. Once you choose to customize, all coefficients are configurable. However, you only have to setup as many as you need. Leave the rest 0%.
2. Make sure you are clear about the definition of the positive and negative. Make sure you are also clear about the relationship between the output quantity and motor rotation speed.
3. Usually, the coefficients of throttle and yaw are 100% or -100%. The rest of the coefficients should be decided by the proportion of force arms of the motors.
4. The method introduced in this section is only suitable for central symmetry multi rotor.

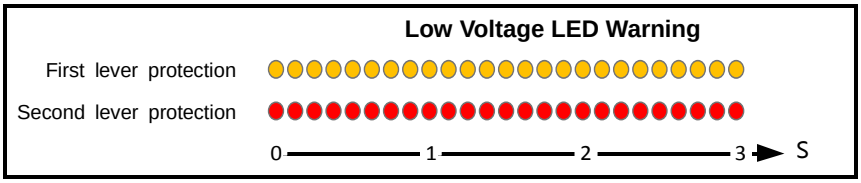
LED Indicator Description



Notices: Here the sparking indication of ●&●could be: **Single spark**, all the sticks return to center, multi rotor hovering; **Double spark**, stick(s) not at center, speed command is not zero.







1 The circle symbols above represent one single spark with special notices.
2 The rectangular symbols above represent an LED being solid on.

MC LED Indicator Description

■ on	MC is functioning well.
■ on	MC is working under boot loader mode, waiting for firmware upgrading.
● blinks	Firmware upgrading is finish. MC is waiting for reboot.
■ on or ● blinks	Error occurs during firmware upgrading, MC reboot is required.

PMU LED Indicator Description

■on	PMU connection is correct.
■on	The connection of PMU and battery is wrong (polarity error).

Product Specifications

General specifications

Built-In Functions:	Autopilot
	Enhanced Fail Safe
	Low Voltage Protection
	S-Bus Receiver Support
Multi Rotor Types:	Quad-rotor I, X; Hex-rotor I, V, Y, IY; Octo-rotor X, I, V.
Supported ESC output:	400Hz refresh frequency
Recommended Transmitter:	PCM or 2.4GHz with minimum 7 channels and
	Failsafe function available on all channels
Output of PW on PMU:	350mA@8V, 300mA@12V, 220mA@16V, 200mA@20V, 160mA@24V
Output of V-SEN on PMU:	3A@5V
Recommended Battery:	2S ~ 6S LiPo
Power Consumption:	MAX 5W (0.9A@5V, 0.7A@5.8V, 0.5A@7.4V, 0.4A@8V)
Operating Temperature:	-5°C to +60°C

（You have to keep the IMU warm if you want to use it under low temperature, could be -5°Cor lower.）

Flight Performance (can be effect by mechanical performance and payloads)

Hovering Accuracy (GPS Mode):	Vertical:	± 0.5m
	Horizontal:	± 2m
Suitable Wind Condition:	< 8m/s (17.7mph)	
Max Yaw Angular Velocity:	150 degree/s	
Max Tilt Angle:	35 °	
Max Vertical Speed :	6m/s	

Packaging & Shapes

Total Weight:	<= 150g	
Dimensions:	Main Controller:	61mm x 39.6mm x 15.8mm
	IMU:	40mm x 31mm x 26mm
	GPS & Compass:	50mm (diameter) x 9mm
	LED Indicator:	25mm x 25mm x 7mm